

Section 3.4: Linear Programming

Essential Question:

What is linear programming?

* A process of optimizing a linear function to find its maximum or minimum value

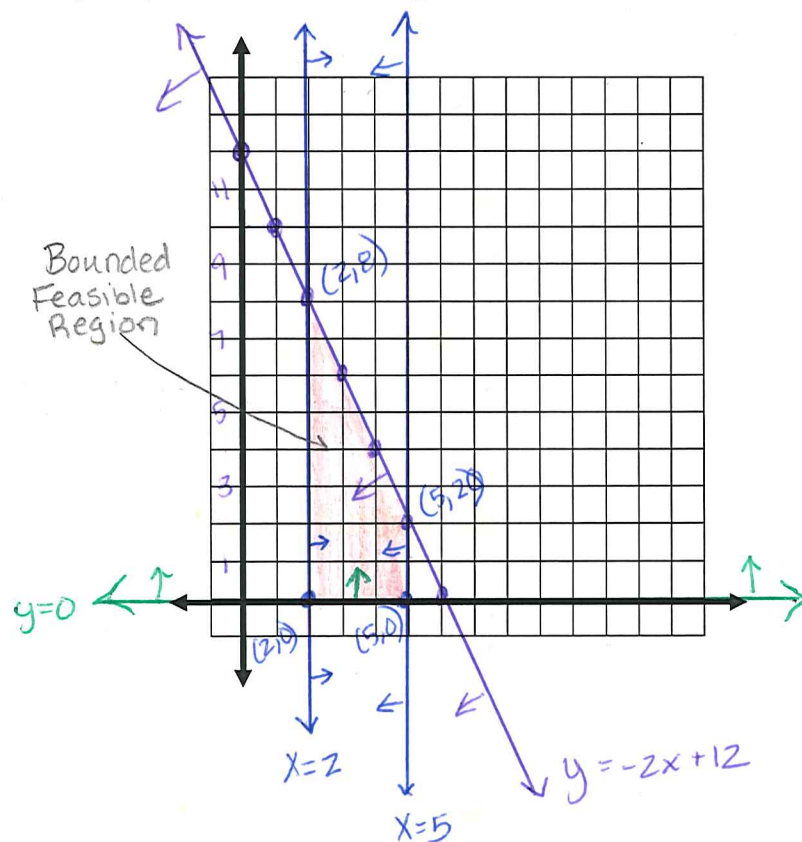
* The process uses...

- 1) An objective function * usually involves money
- 2) Constraints (in the form of inequalities)
- 3) Graph that is called the feasible region

Example 1Find the minimum and maximum value of $C = -x + 3y$ subject to the following constraints:

- $x \geq 2$
- $x \leq 5$
- $y \geq 0$
- $y \leq -2x + 12$

Vertices	Value of function $(-x + 3y)$
$(2, 0)$	$C = -(2) + 3(0) = -2$
$(2, 8)$	$C = -(2) + 3(8) = 22$
$(5, 0)$	$C = -(5) + 3(0) = -5$
$(5, 2)$	$C = -(5) + 3(2) = 1$

Minimum occurs @ $(5, 0)$ $C = -5$ Maximum occurs @ $(2, 8)$ $C = 22$ **CORNER POINT PRINCIPLE**The maximum and minimum values occur at a vertex of the feasible region.

Example 2

Find the min and max value of $C = x + 5y$ subject to the following constraints

$x \geq 0$

$5 \geq x + y \rightarrow y \leq -x + 5$

$y - 2 \leq 2x$

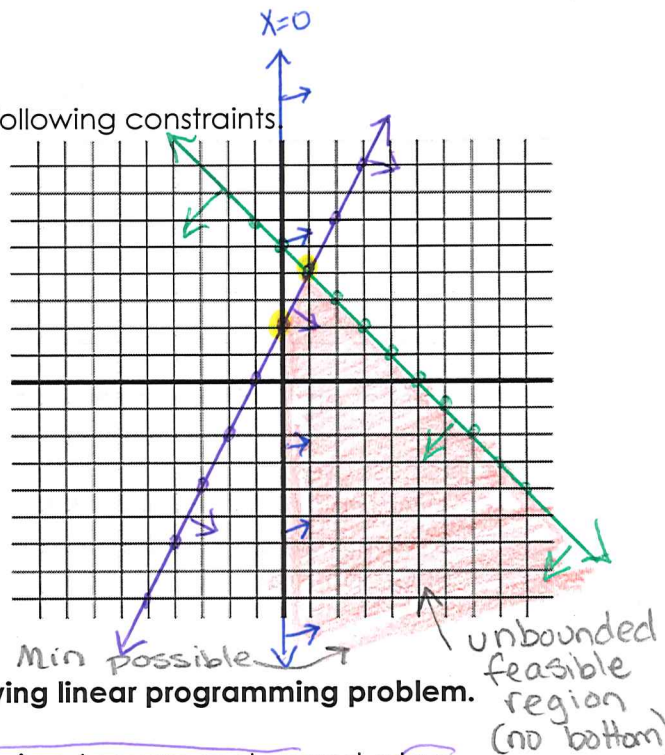
$y \leq 2x + 2$

only 2 vertices

$(0, 2) \quad C = 0 + 5(2) = 10$

$(1, 4) \quad C = 1 + 5(4) = 21$

Max = 21 @ (1, 4)



Example 3

Write the constraints and objective function for the following linear programming problem.

The area of a parking lot is 600 square meters. A car requires 6 square meters and a bus requires 30 square meters. The attendant can only handle 60 vehicles. If a car is charged \$2.50 and a bus \$7.50, how many of each should be accepted to maximize income?

Step #1

Define the variables. Be SPECIFIC!!!

* Look at the question being asked

$x =$ number of cars
 $y =$ number of buses

Step #2

Write the Objective function

usually involves money

- contains information about maximizing or minimizing

$C = 2.50x + 7.50y$

Step #3

Write the constraints.

- These are the linear inequalities
- look for limitations!

* look for common labels (sq. meters)

$6x + 30y \leq 600 \rightarrow 30y \leq -6x + 600$
 $x + y \leq 60 \rightarrow y \leq -x + 60$
 $y \leq -\frac{1}{5}x + 20$
 $y \leq -x + 60$
 $\left. \begin{matrix} x \geq 0 \\ y \geq 0 \end{matrix} \right\}$ common sense can't have negative #

Step #4

Graph the constraints.

Step #5

Determine vertices and find max or min

Vertices

Value of function

Vertices

Value of function

$(0, 0)$

$2.50(0) + 7.50(0) = 0$

$(50, 10)$

$2.50(50) + 7.50(10) = 200$

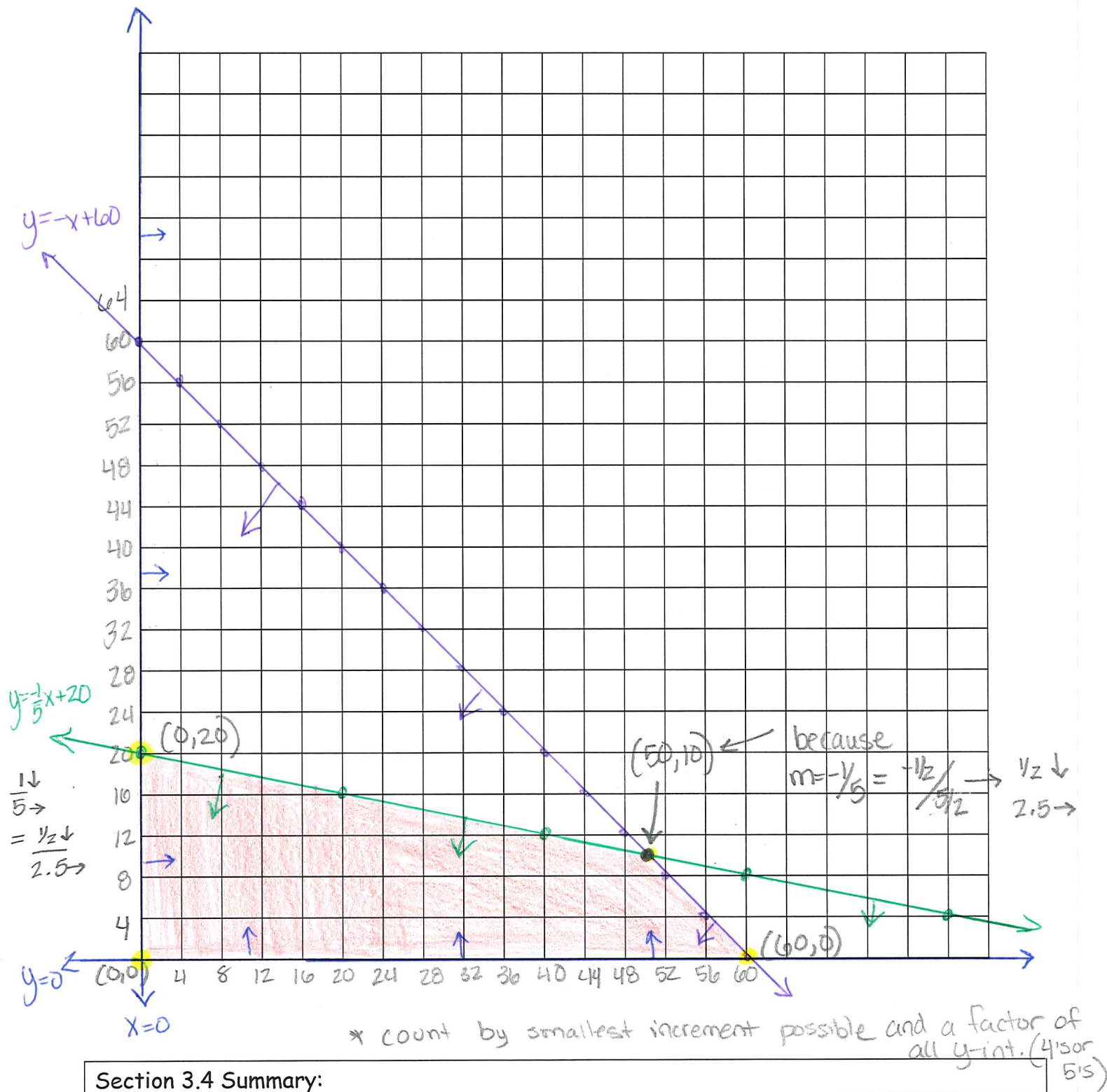
$(0, 20)$

$0 + 7.50(20) = 150$

$(60, 0)$

$2.50(60) + 0 = 150$

Maximum income is \$200, with 50 cars and 10 buses



Section 3.4 Summary:

Linear programming is the application of graphing inequalities to find maximum or minimum values of an objective function, which usually relates to income or profit.

- Steps to L.P
- ① graph inequalities
 - ② Evaluate the vertices of the feasible region in objective function to determine the max or min value